CLAIMS

1. A rail non-contact vehicle comprising:

wheels;

a vehicle main body supported by said wheels; and

a steering control system,

wherein said steering control system comprises:

a control section configured to control a steering of said wheels in a non-mechanical manner; and

a drive section configured to mechanically drive the steering of said wheels,

said control section comprises:

a first detector configured to detect 1-dimensional coordinate data of a target route;

a steering angle holding section configured to hold a target steering angle corresponding to said 1-dimensional coordinate data;

a second detector configured to detect a current deviation between said target route and a current position of said vehicle main body; and

a control steering angle calculating section configured to generate a control steering angle corresponding to said current deviation and said target steering angle,

said current deviation is defined as a

distance to said current position of said vehicle main body in a direction orthogonal to said target route, and

said drive section turns an orientation of said wheels based on said control steering angle.

2. The rail non-contact vehicle according to claim 1, wherein said target route is set on a road surface, and said second detector detects said position deviation in a non-contact manner.

3. The rail non-contact vehicle according to claim 1, further comprising:

a calculating section provided on said vehicle main body, and

wherein said calculating section calculates and holds a 2-dimensional coordinate data by integrating a velocity data of said vehicle main body.

4. The rail non-contact vehicle according to claim 1, wherein said target route is set on a road surface and comprises an output section configured to output said 1-dimensional coordinate data, and

said 1-dimensional coordinate data is transmitted from said output portion to said first detector in wireless.

5. The rail non-contact vehicle according to claim 4, wherein said target steering angle is written in a running route.

6. The rail non-contact vehicle according to claim 1, wherein said control section further comprises:

a third detector configured to detect a velocity of said vehicle main body, and

a steering angle control section generates a control data corresponding to said position deviation, said desired steering angle, and said velocity.

7. The rail non-contact vehicle according to claim 1, wherein said control section further comprises:

an optimization calculating section configured to optimize said control steering angle to an optimal solution, and

said optimal solution is determined to minimize vibration resulting from the steering of said vehicle.

8. The rail non-contact vehicle according to claim 1, wherein said control section further comprises:

a steering angle correction controller

configured to determine a future steering angle corresponding to a future position on said target route, and to generate a correction steering angle corresponding to said current deviation, said target steering angle, and said future steering angle, and

said control steering angle calculating section generates said control steering angle corresponding to said current deviation, said target steering angle, and said correction steering angle.

9. The rail non-contact vehicle according to claim 8, wherein said control section further comprises:

a second detector configured to detect said current steering angle to said current position when said vehicle carries out a N-th run of said target route; and

an optimal solution calculating section configured to determine a current optimal target steering angle from all or a part of said current steering angles for N times, and

said optimal solution calculating section determines said current optimal target steering angle such that vibration resulting from the steering of said vehicle is minimized.

10. The rail non-contact vehicle according to

claim 9, wherein said optimal solution calculating section comprises a neural network configured to determine said correction steering angle.

11. The rail non-contact vehicle according to claim 9, wherein said optimal solution calculating section executes a program to determine said correction steering angle based on genetic algorithm.

12. The rail non-contact vehicle according to claim 11, wherein said optimal solution calculating section executes a program to determine said correction steering angle based on genetic algorithm.

13. The rail non-contact vehicle according to claim 8, wherein said control section further comprises:

an optimization calculating section configured to optimize a control data, and

said optimization calculating section minimizes vibration resulting from the steering of said vehicle.

14. The rail non-contact vehicle according to claim 13, wherein when m and n take an optional one of a plurality of combinations of m and n, a deviation between a position of said vehicle main body at a m-th

run and an n-th run on said target route is expressed as an amplitude, and

said optimization calculating section determines said correction steering angle such that a sum of squares of the amplitudes is minimized.

15. The rail non-contact vehicle according to claim 13, wherein when m and n take an optional one of a plurality of combinations of m and n, an acceleration of said vehicle main body between the m-th run and the n-th run on said target route is expressed, and

said optimization calculating section determines said correction steering angle such that a sum of squares of the accelerations is minimized.

16. The rail non-contact vehicle according to any of claims 1 to 15, further comprising:

a cart supported by said wheels; and

a safety bar supported by said cart and configured to contact a rail side fixed object,

said drive section is interposed between said cart and said wheels, and

a displacement portion of said drive section is mechanically connected with said wheels and said safety bar.

17. The rail non-contact vehicle according to claim 16, wherein said displacement portion is a ball screw driven by a motor or a nut connected to said ball screw.

18. The rail non-contact vehicle according to claim 16, wherein said displacement portion is a cylinder driven with a fluid pressure source or a piston rod connected to said cylinder.

19. A rail non-contact vehicle comprising:

wheels;

a cart supported by said wheels; and

a steering apparatus, and

wherein said steering apparatus comprises:

a motor;

a screw axis connected with an output axis of said motor;

bearings configured to support said screw axis;

a nut screwed with said screw axis;

a first support configured to support said nut;

a second support configured to support said bearings; and

a link mechanism configured to steer said wheels, and

either of said first support and said second support constitutes a fixation side support fixed to said cart, and either of said first support and said second support constitutes a movable side support connected with said link mechanism.

20. The rail non-contact vehicle according to claim 19, further comprising:

a safety bar; and

safe rings supported by the safety bar, and

said safety bar is connected with said movable side support,

said cart is connected with said fixation side support, and

said nut is supported by the cart.

21. The rail non-contact vehicle according to claim 19, wherein said motor and said bearings are supported by said safety bar.

22. The rail non-contact vehicle according to claim 20 or 21, wherein said steering apparatus further comprises:

a clutch interposed between said screw axis and said motor, and

connection of said clutch is released in response to contact of said safe rings and said rail

side fixed object.

23. The rail non-contact vehicle according to claim 19, wherein said nut is supported by said link mechanism, and said motor and said bearings are supported by said cart.

24. The rail non-contact vehicle according to any of claims 19 to 23, wherein said screw axis constitutes a ball screw axis.

25. A rail non-contact vehicle comprising:

wheels;

a cart supported by said wheels, and

a steering unit, and

said steering machine comprises:

a motor;

a movable body connected with an output axis of said motor;

a safety bar provided with safe rings, and

a link mechanism configured to steer said wheels,

said link mechanism is connected with said safety bar and said movable body, and

said safety bar is movably supported to said cart, and said motor is fixedly supported by said cart.

26. The rail non-contact vehicle according to claim 25, wherein said output axis of said motor is connected with a movable body via a pinion and a rack.

27. A rail non-contact vehicle comprising:

wheels;

a cart supported by said wheels; and

a steering unit, and

wherein steering unit comprises:

a motor;

a screw axis connected with an output axis of said motor; bearings configured to support said screw axis;

a nut screwed in said screw axis;

a link mechanism configured to steer said wheels; and

a safety bar provided with safe rings,

said safety bar, said motor, and said bearings are fixedly supported by said cart, and

said nut is connected with said link mechanism.

28. The rail non-contact vehicle according to claim 27, wherein said steering unit further comprises:

a clutch interposed between said screw axis and said motor, and

connection of said clutch is released in response to a contact of said safe rings and said rail side fixed object.

29. A method of steering a rail non-contact vehicle, comprising:

setting of a 1-dimensional coordinate data of a target route;

setting of a target steering angle corresponding to said 1-dimensional coordinate data X_j;

detecting a current deviation between said target routes and a current position of a vehicle main body;

generating a control steering angle corresponding to said current deviation and said target steering angle; and

turning orientation of wheels to an angle position corresponding to said control steering angle, and

wherein said current deviation is defined as a distance of said current position in a direction orthogonal to said target route.

30. The steering method according to claim 29, further comprising:

setting a future target steering

corresponding to a future position on said target route; and

generating a correction steering angle corresponding to the future steering angle, and

wherein said control steering angle is determined based on said current deviation, said target steering angle, and said correction steering angle.

31. A steering method of a rail non-contact vehicle, wherein a drive section comprises a motor, a ball screw axis connected with an output axis of said motor, and a nut connected with the ball screw axis, a clutch interposed between said motor and said ball screw axis, and a link mechanism connected with said wheels and configured to operate a rotation of the output axis of said motor,

said steering method further comprises:

detecting a contact between a part of said vehicle with a road surface side structure; and

disengaging said clutch interposed therebetween in response to the contact.